

Endocarditis and Its Complications: The Role of Echocardiography

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Disclosures

- ✓ No relevant financial disclosures



Endocarditis

- > 50,000 cases/yr in US (47,000 Medicare hospitalizations/year)
- Left sided - Majority of cases
- Highest mortality and complication rate

- ✓ Review
 - Guidelines for prophylaxis
 - Diagnosis and indications for TEE
 - Identification of complications
 - Prognostic (echocardiographic) features
 - Indications for surgery

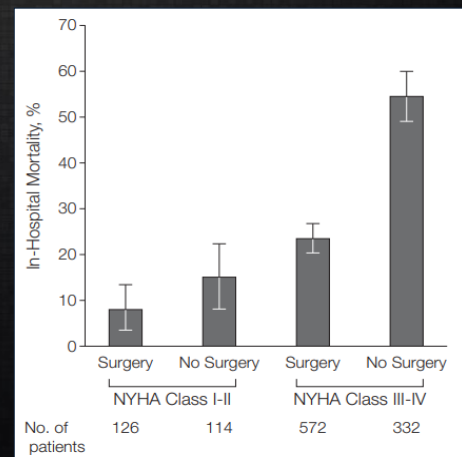


CDC/Dr. Edwin P. Ewing, Jr.



ICE-PCS

- ✓ 4100+ hospitalized cases of IE with CHF
- ✓ 30% 1 month mortality
- ✓ 33% of patients with advanced CHF (Class III or IV)
- ✓ In-hospital mortality of IE (without CHF) 13%



Keifer T et al. JAMA 2011



Prevention

- ✓ Antibiotic prophylaxis recommended:
 - Prosthetic heart valves or prosthetic material valve repair
 - History of endocarditis
 - Heart transplant with abnormal valve function
 - Certain congenital heart defects
 - Cyanotic heart disease, not fully repaired
 - Within 6 months of repair of defect
 - Repairs with residual defects and/or leaks

American Heart Association 2007



Infective Endocarditis Prophylaxis

NOT recommended for:

- Transesophageal echocardiography
- EGD
- Colonoscopy
- Cystoscopy without ongoing infection

Regardless of valvular/endocarditis risk



2017 AHA/ACC Focused Update

- Antibiotic prophylaxis before dental procedures now is also recommended for:
 - Patients with transcatheter prosthetic valves, and for
 - Patients with prosthetic material used in valve repair
 - Annuloplasty rings and/or artificial chords
 - Class IIa, Level of Evidence [LOE] C-LD

Nishimura RA et al. 2017 AHA/ACC Focused Update of 2014 Guidelines



PREVENTION OF INFECTIVE (BACTERIAL) ENDOCARDITIS

This wallet card is to be given to patients (or parents) by their physician. Healthcare professionals: Please see back of card for reference to the complete statement.

Name: _____

_____ needs protection from

INFECTIVE (BACTERIAL) ENDOCARDITIS

because of an existing heart condition.

Diagnosis: _____

Prescribed by: _____

Date: _____

You received this wallet card because you are at increased risk for developing adverse outcomes from infective endocarditis (IE), also known as bacterial endocarditis (BE). The recommendations for prevention of IE shown in this card are based on the current AHA guideline.

Members of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the American Heart Association's Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee together with national and international experts on IE extensively reviewed published studies in order to determine whether dental, gastrointestinal (GI), or genitourinary (GU) tract procedures are possible causes of IE. These experts determined that there is no conclusive evidence that links GI or GU tract procedures with the development of IE. They also concluded that antibiotics before dental procedures are reasonable for certain patients at increased risk of developing IE and at highest risk of poor outcomes from IE.

The practice of routinely giving antibiotics to patients at risk for endocarditis prior to a dental procedure is not recommended **EXCEPT** for patients with the highest risk of adverse outcomes resulting from IE (see below on this card). The Committees could not exclude the possibility that an exceedingly small number of cases, if any, of IE may be prevented by antibiotic prophylaxis prior to a dental procedure. If such benefit from prophylaxis exists, it should be reserved **ONLY** for those patients listed below. The Committees recognize the importance of good oral and dental health and regular visits to the dentist for patients at risk of IE.

These guidelines do not change the fact that your cardiac condition puts you at increased risk for developing endocarditis. If you develop signs or symptoms of endocarditis—such as unexplained fever—see your doctor right away. If blood cultures are necessary to determine if endocarditis is present, it is important for your doctor to obtain these cultures and other relevant tests **BEFORE** antibiotics are started.

Antibiotic prophylaxis with dental procedures is reasonable for patients with cardiac conditions associated with the highest risk of adverse outcomes from endocarditis, including:

- Prosthetic cardiac valves, including transcatheter-implanted prostheses and homografts
- Prosthetic material used for cardiac valve repair, such as annuloplasty rings and chords
- Previous endocarditis
- Congenital heart disease (CHD) only in the following categories:
 - Unrepaired cyanotic CHD, including those with palliative shunts and conduits
 - Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or catheter intervention, during the first six months after the procedure
 - Repaired CHD with residual shunts or valvular regurgitation at the site or adjacent to the site of a prosthetic patch or prosthetic device which inhibit endothelialization
- Cardiac transplantation recipients with valve regurgitation due to a structurally abnormal valve

*Except for the conditions listed above, antibiotic prophylaxis before dental procedures is not recommended for any other form of CHD.

†Prophylaxis is reasonable because endocardial colonization of prosthetic material occurs within six months after the procedure.

Dental procedures for which prophylaxis is reasonable in patients with cardiac conditions listed on reverse side.

Prophylaxis against IE is reasonable before dental procedures that involve manipulation of gingival tissue or the periapical region of teeth, or perforation of the oral mucosa.

***Antibiotic prophylaxis is NOT recommended for the following dental procedures or events:** routine anesthetic injections through nonhealed tissue, dental radiographs, placement of removable prosthodontic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, and shedding of deciduous teeth and bleeding from trauma to the lips or oral mucosa.

Antibiotic Prophylactic Regimens for Dental Procedures

Situation	Agent	Regimen—Single Dose 30-60 minutes before procedure	
		Adults	Children
Oral	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin OR	2 g IM or IV	50 mg/kg IM or IV
	Cefazolin or cephalexin	1 g IM or IV	50 mg/kg IM or IV
Allergic to penicillins or ampicillin— Oral regimen	Cephalexin ^{††}	2 g	50 mg/kg
	OR		
Allergic to penicillins or ampicillin and unable to take oral medication	Clinidamycin	600 mg	20 mg/kg
	OR		
Allergic to penicillins or ampicillin and unable to take oral medication	Clindamycin	600 mg	20 mg/kg
	OR		
Allergic to penicillins or ampicillin and unable to take oral medication	Cefazolin or ceftriaxone [†]	1 g IM or IV	50 mg/kg IM or IV
	OR		
Allergic to penicillins or ampicillin and unable to take oral medication	Cefazolin or ceftriaxone [†]	1 g IM or IV	50 mg/kg IM or IV
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	OR		
Allergic to penicillins or ampicillin and unable to take oral medication	Cefazolin or ceftriaxone [†]	1 g IM or IV	50 mg/kg IM or IV
	OR		

††—Intravenous. IV—intravenous.

*For other first or second generation oral cephalosporins in equivalent adult or pediatric dosage.

†Cephalexins should not be used in an individual with a history of anaphylaxis, angioedema or urticaria with penicillins or ampicillin.

Gastrointestinal/Genitourinary Procedures: There is no evidence for IE prophylaxis in GI or GU procedures absent known enterococcal infection.

Other Procedures: procedures involving the respiratory tract or infected skin, tissues just under the skin, or musculoskeletal tissue for which prophylaxis is reasonable are discussed in the document referenced below.

Adapted from Prevention of Infective Endocarditis: Guidelines from the American Heart Association, by the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease. Circulation. 2007;116:1756-1758. Available at: <http://circ.ahajournals.org/lookup/other/116/1756>.

Healthcare Professionals—Please refer to these recommendations for more complete information as to which patients and which dental procedures it would be reasonable for antibiotic prophylaxis to reduce risk of infective endocarditis.

ADA American Dental Association

The Council on Scientific Affairs of the American Dental Association has approved this statement as a policy on dentistry.

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Diagnosis

- ✓ At least 2 sets of blood cultures
- ✓ Modified Duke Criteria for suspected IE
- ✓ Transthoracic recommended in those with suspected IE
 - Assess for vegetations
 - Assess hemodynamic severity of valve lesions
 - Assess cardiac function
 - Re-evaluation for clinical change/symptoms

Nishimura et al. Valvular Heart Disease Guidelines, JACC 2014



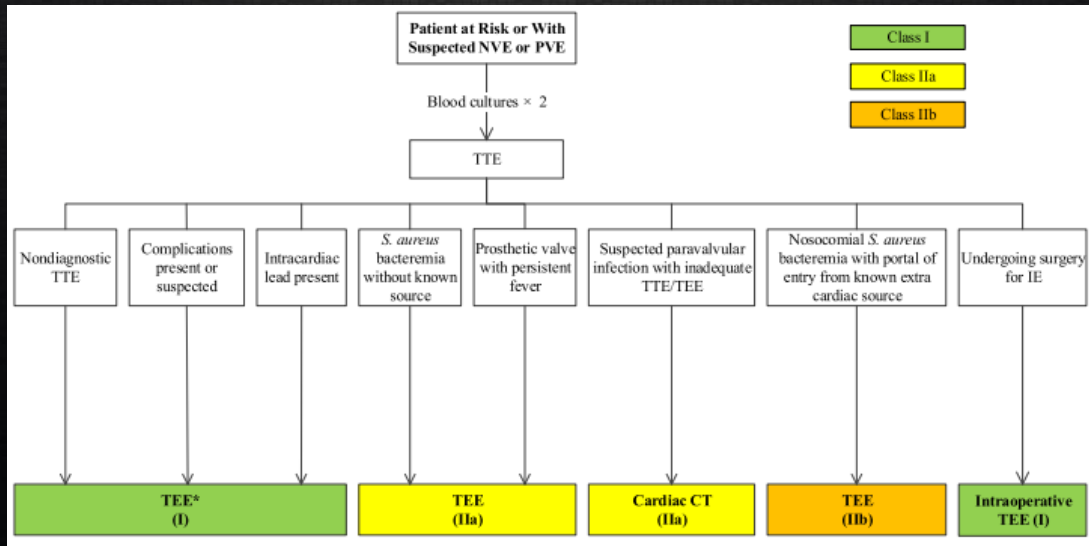
Modified Duke Criteria

- ✓ Definite infective endocarditis
 - Clinical Criteria
 - 2 Major criteria, or
 - 1 Major criterion and 3 minor criteria, or
 - 5 Minor criteria
 - Major criteria
 - Blood culture positive
 - Typical microorganism for IE (multiple variations)
 - Endocarditis by imaging study

Circulation 2005;111:e394-434



Imaging Recommendations



Nishimura et al. Valvular Heart Disease Guidelines, JACC 2014



Echocardiography Criteria

- ✓ Evidence of endocarditis
 - **Oscillating intracardiac mass on valve or supporting structures, in the path of regurgitant jets**, or on implanted material in the absence of an alternative anatomic explanation, or
 - **Abscess**, or
 - New **partial dehiscence** of prosthetic valve, or
 - New valvular regurgitation

Circulation 2005;111:e394-434



Rule Out Endocarditis!

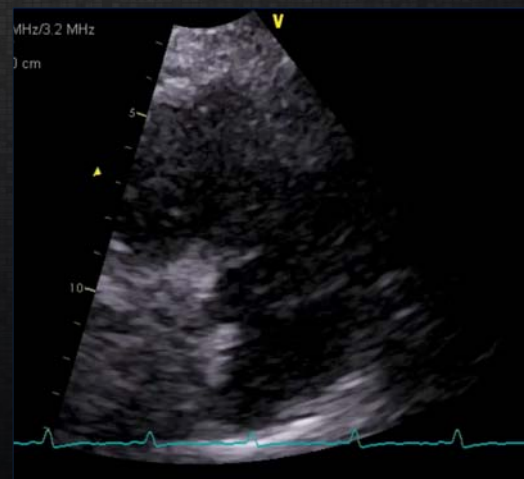
➤ Negative or non-diagnostic TTE

- TEE if clinical suspicion high
- If TEE negative and clinical suspicion persists
 - **REPEAT** studies at 5-12 days
 - Vegetations or abscess may now be present
 - If still negative, look for another source
 - Pacemaker, vascular grafts, catheters, PDA
 - CIED (Cardiac Implantable Electronic Device) Infections



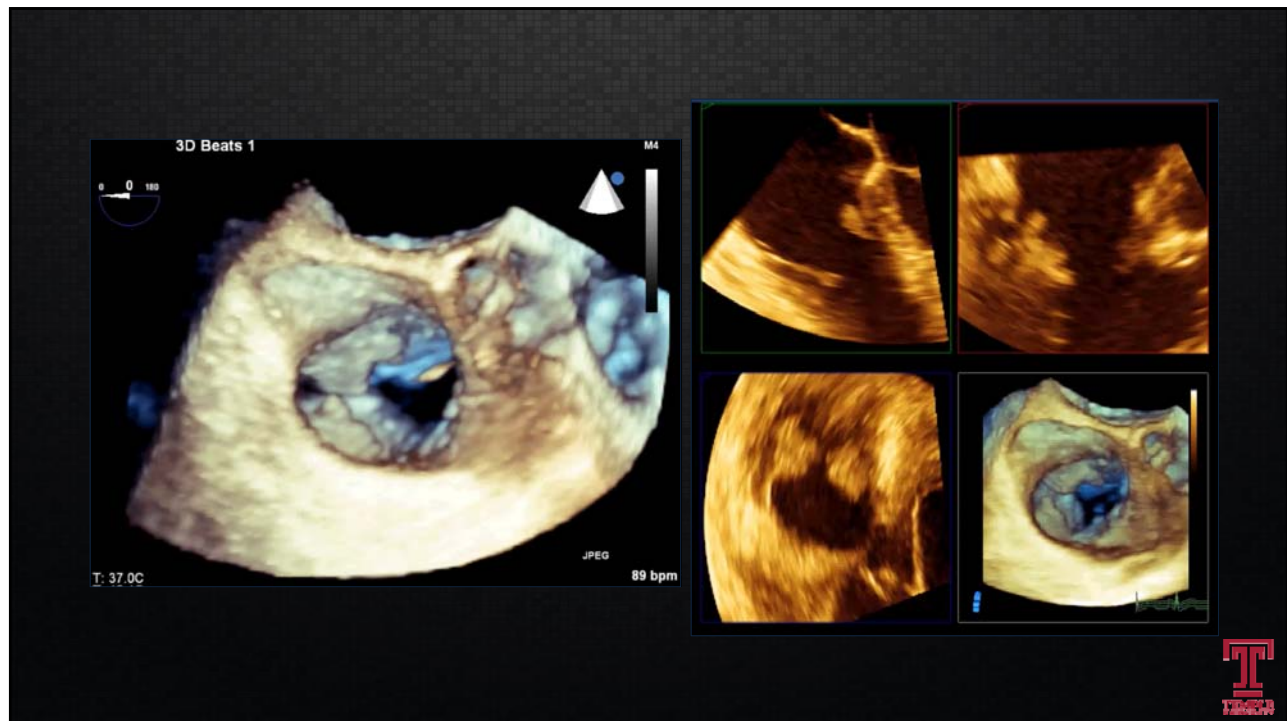
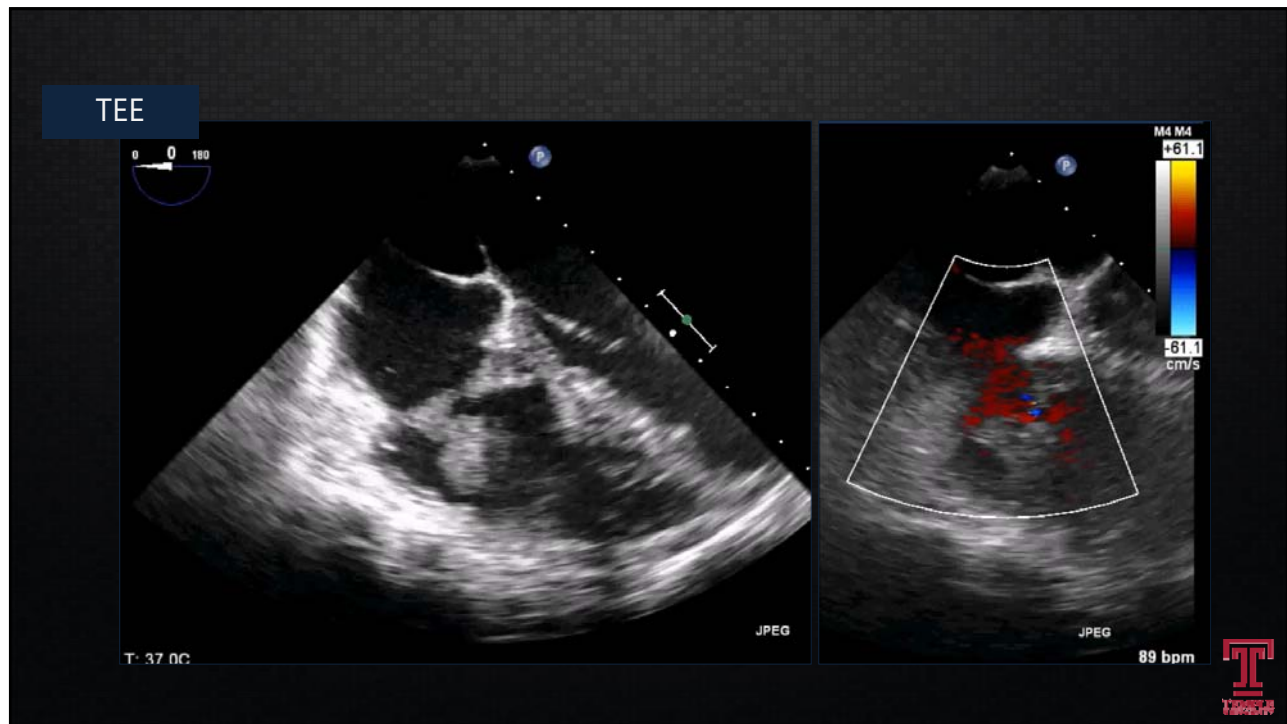
Rule out Endocarditis!

TTE



47 yo Female, IV drug abuse, +Blood cultures (MRSA), persistent fevers.





Echocardiography

Transthoracic

- ✓ Resolution ~ 3-4 mm
- ✓ Sensitivity: 62-82%
- ✓ Specificity: 91-100%
- ✓ Readily available, usual initial test of choice

Transesophageal

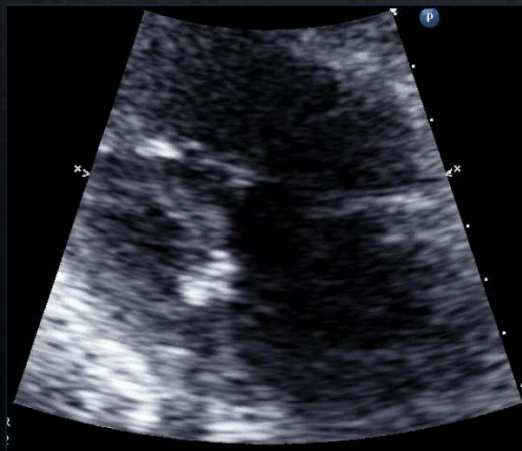
- ✓ Resolution ~ 1-2 mm
- ✓ Sensitivity: 87-100%
- ✓ Specificity: 91-100%
- ✓ Greater (3-4x) sensitivity for prosthetic valves

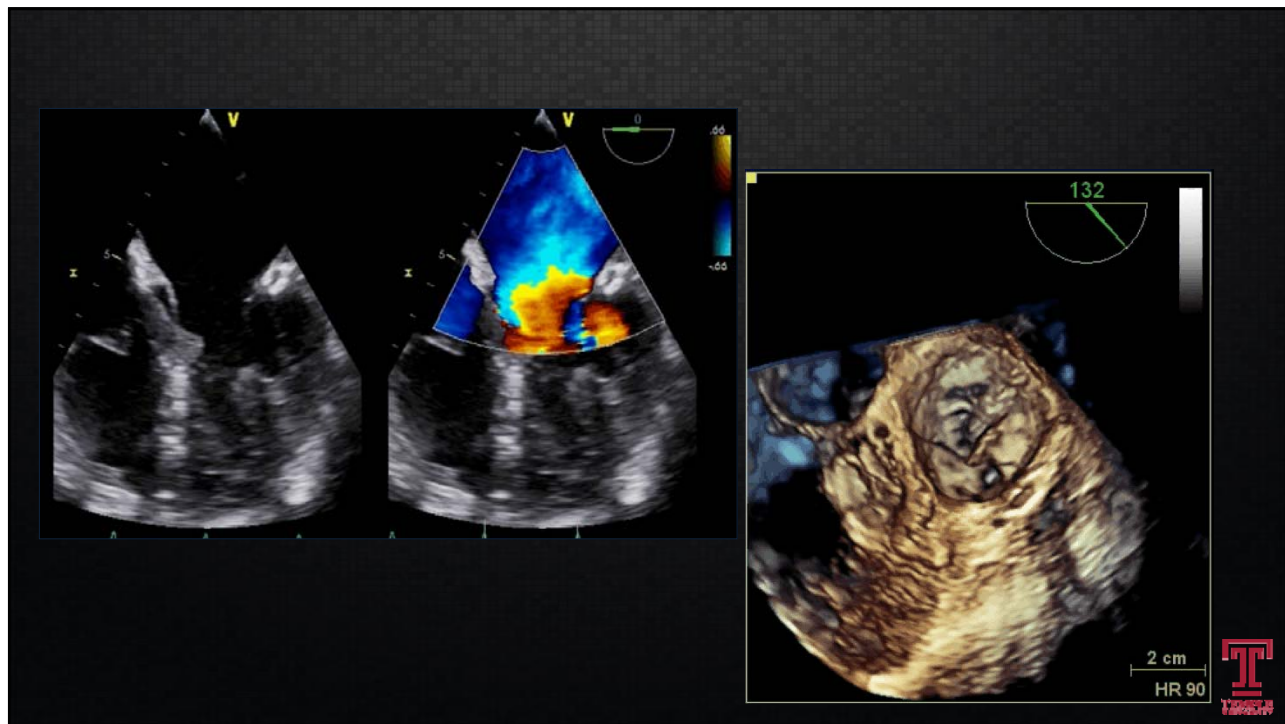
Jacob S et al. Curr Opin Cardiol 2002;
Kini V et al. JASE 2010; Pederson WR et al. Chest 1991



Case

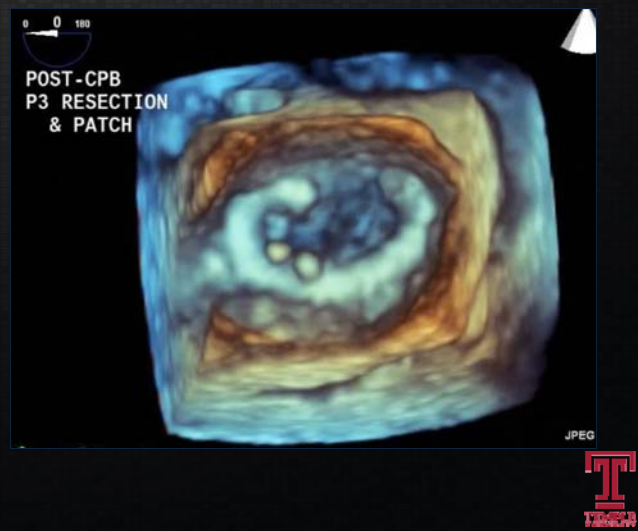
58 yo Female, chronic IV drug abuse presents with fever and malaise. +Blood cultures (MSSA). Acute HF





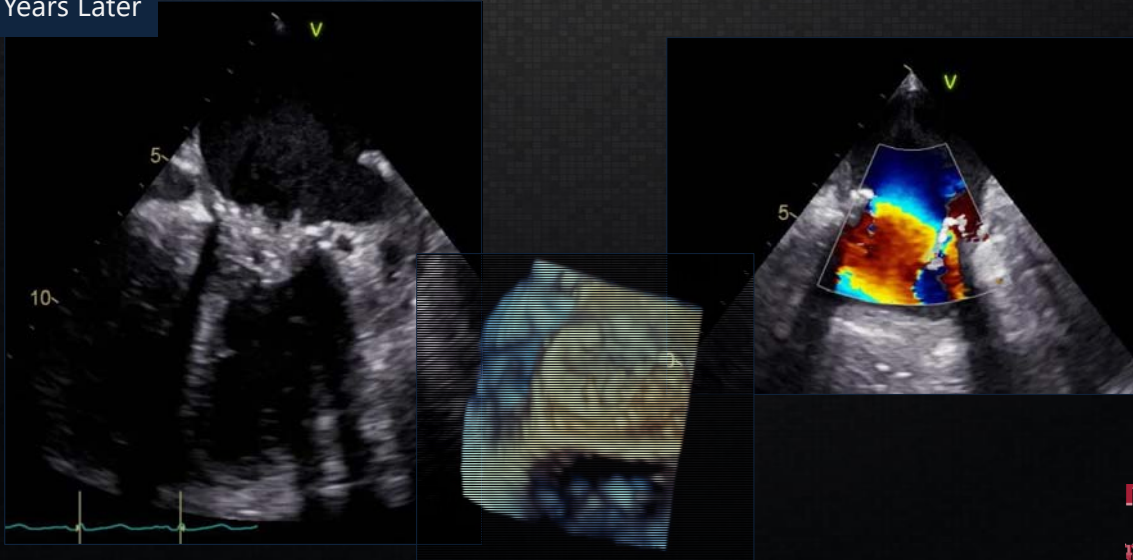
Post-Op

- Surgery:
 - Totally endoscopic robotic repair
 - P3 Resection
 - Pericardial patch repair
 - Mitral annuploasty ring
 - No significant MR



Old Habits Die Hard

3 Years Later

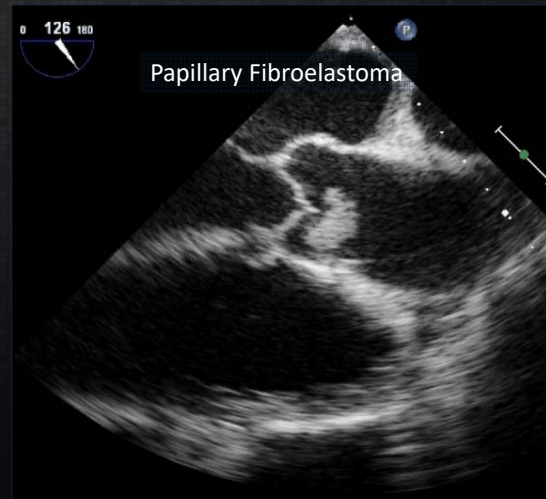


Leaflet Aspect

- ✓ Infective endocarditis
 - More commonly seen on the **upstream aspect**
 - Ventricular surface of AV with AI
 - Atrial surface of MV with MR
 - Usually at a site of endothelial damage
- ✓ **Downstream Aspect**
 - Usually a degenerative finding
 - Papillary fibroelastoma
 - Chordal structure (MV)
 - Less likely associated with significant regurgitation

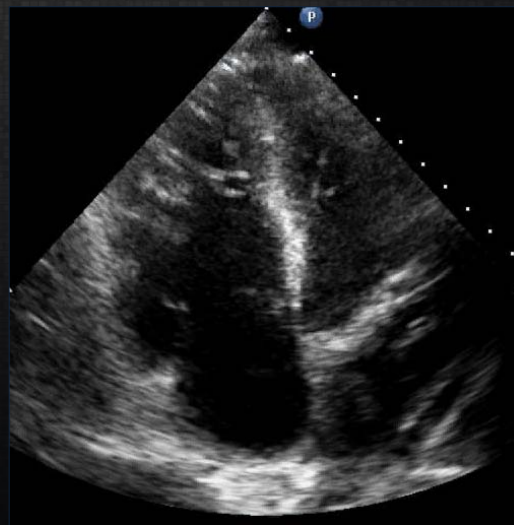


Downstream Aspect

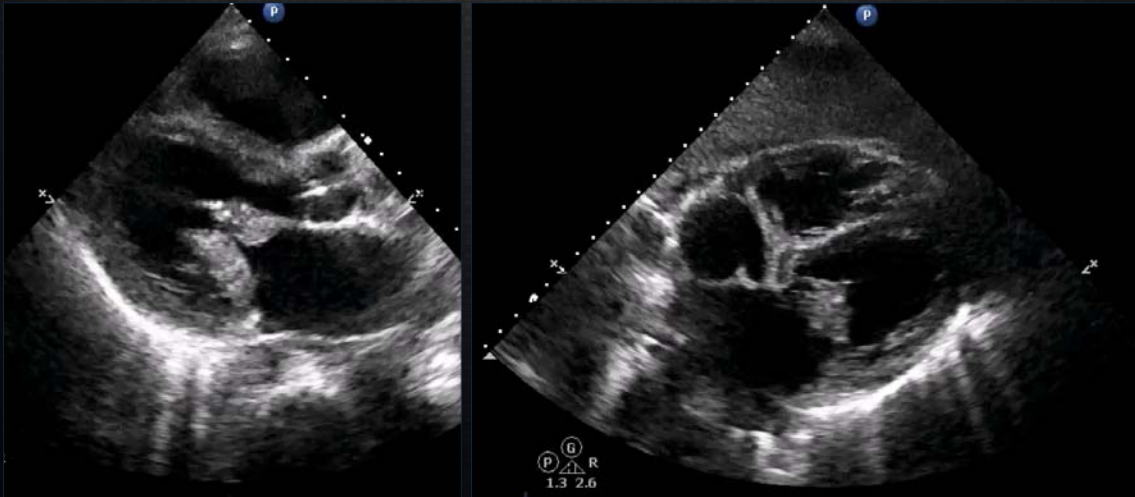


Downstream Aspect

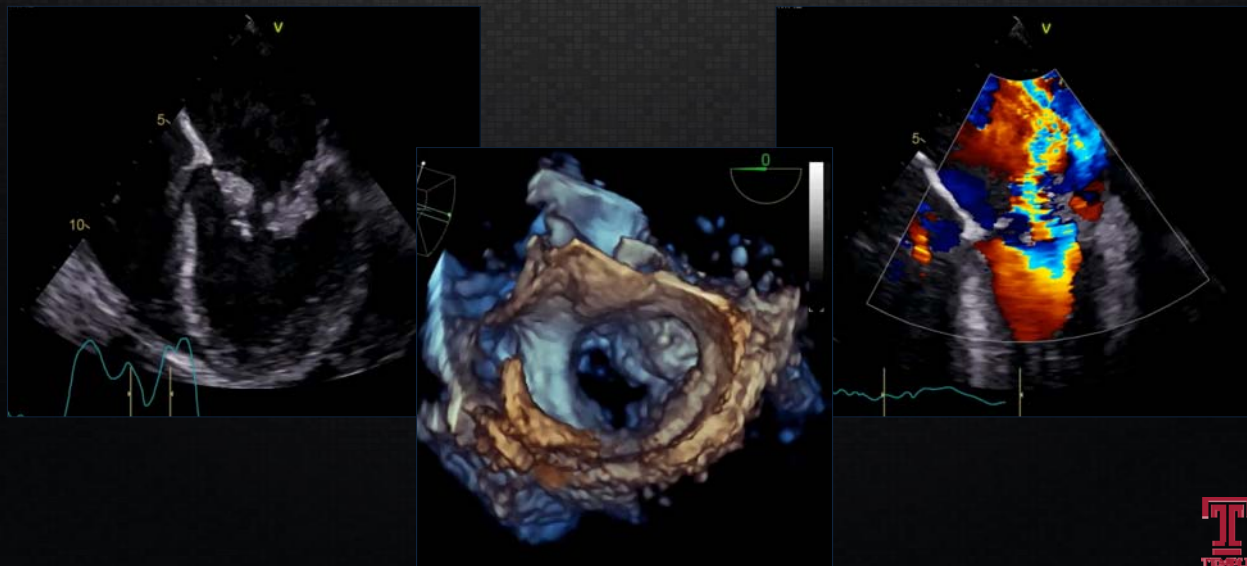
47yo Male presenting
with acute DVT and PE



Upstream or Downstream?

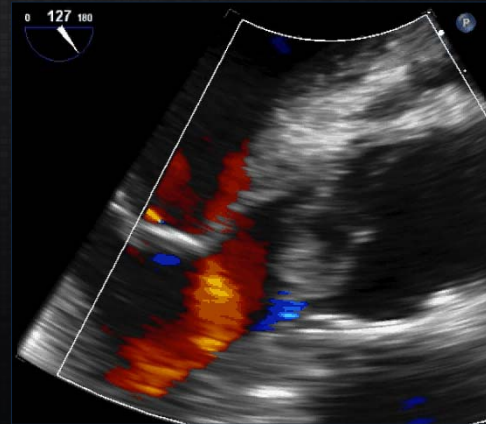


TEE

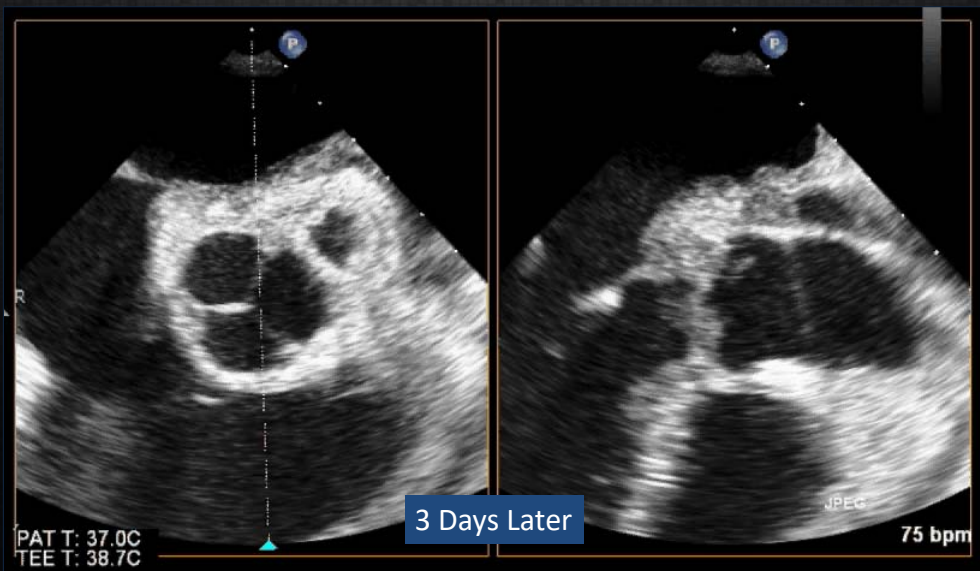


Case

49 yo Male with a progressive mandibular infection and +Blood cultures (Strep pneumo)

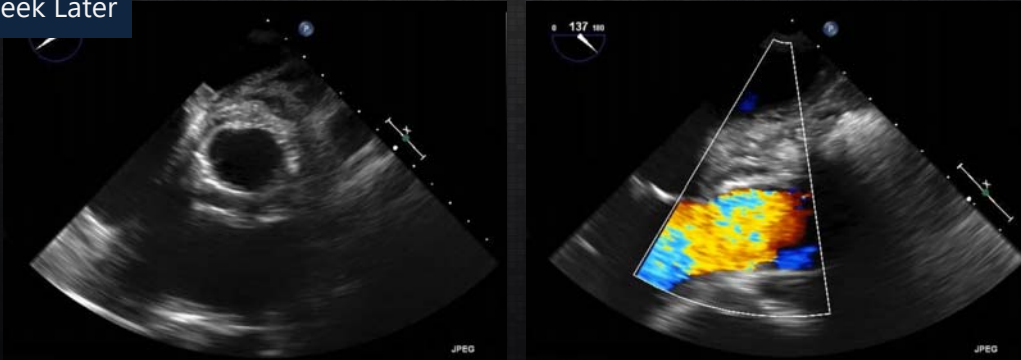


Natural History



Surgery

1 Week Later



Underwent a Ross procedure (pulmonary autograft) with aortic root reconstruction



Complications of IE

- ✓ Leaflet perforation
- ✓ **Aortic root abscess**
- ✓ Annular perforation
- ✓ **Fistula formation**
- ✓ Embolism
- ✓ **Purulent pericarditis**
- ✓ Hardware infection
- ✓ Erosion



Glossary

	Surgery/necropsy	Echocardiography
Fistula	Communication between two neighbouring cavities through a perforation.	Colour-Doppler communication between two neighbouring cavities through a perforation.
Valve aneurysm	Saccular outpouching of valvular tissue.	Saccular bulging of valvular tissue.
Dehiscence of a prosthetic valve	Dehiscence of the prosthesis.	Paravalvular regurgitation identified by TTE/TOE, with or without rocking motion of the prosthesis.

	Surgery/necropsy	Echocardiography
Vegetation	Infected mass attached to an endocardial structure or on implanted intracardiac material.	Oscillating or non-oscillating intracardiac mass on valve or other endocardial structures, or on implanted intracardiac material.
Abscess	Perivalvular cavity with necrosis and purulent material not communicating with the cardiovascular lumen.	Thickened, non-homogeneous perivalvular area with echodense or echolucent appearance.
Pseudoaneurysm	Perivalvular cavity communicating with the cardiovascular lumen.	Pulsatile perivalvular echo-free space, with colour-Doppler flow detected.
Perforation	Interruption of endocardial tissue continuity.	Interruption of endocardial tissue continuity traversed by colour-Doppler flow.

2015 ESC Guidelines for Infective Endocarditis

ESC

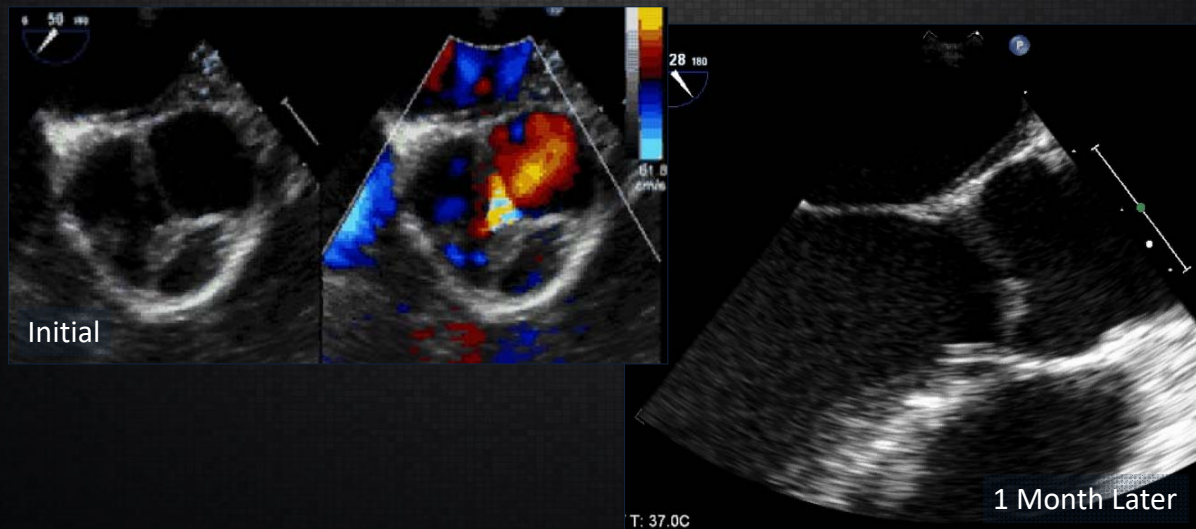
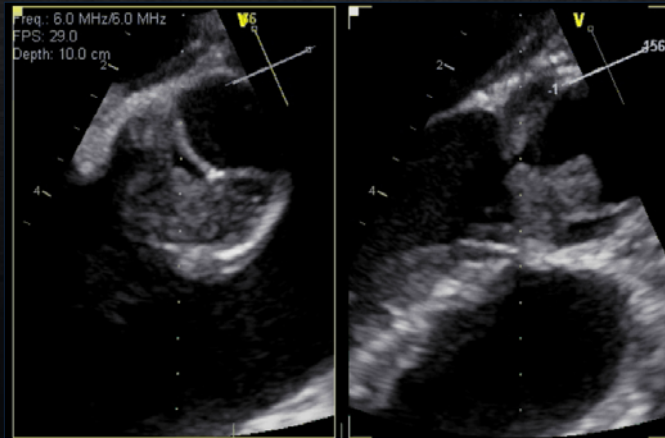
Indications for Early Surgery

- ✓ Valve dysfunction/ADHF
- ✓ Resistant organisms: Staph Aureus, Fungus
- ✓ Heart block or abscess formation
- ✓ Large mobile vegetation
- ✓ Persistent positive blood cultures
- ✓ Prosthetic valve endocarditis
- ✓ Fungal endocarditis
- ✓ Recurrent embolization

ESC

Case

18 yo Female present with an acute L MCA stroke and lower extremity thromboembolism. Negative blood cultures. New dx SLE



Treated with SC Lovenox. Returned for followup TEE.
Moderate aortic insufficiency (improved).
Dx: Libman-Sacks Endocarditis

Differential Diagnosis

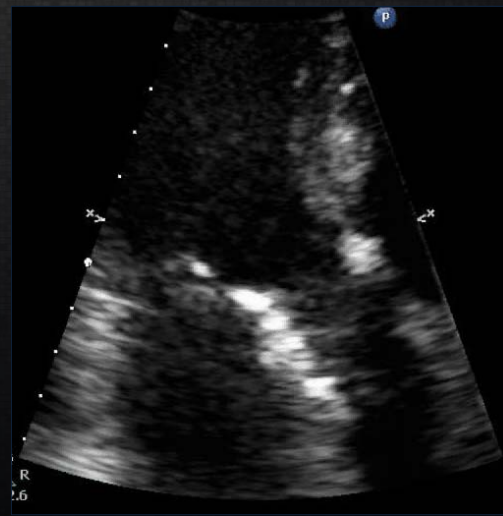
- ✓ Vegetation
 - Infective vs. non-infective/marantic
- ✓ Lambl's excrescence
- ✓ Papillary fibroelastoma (PFE)
- ✓ Thrombus
- ✓ Ruptured chord
- ✓ Valvular strands
- ✓ Myxomatous



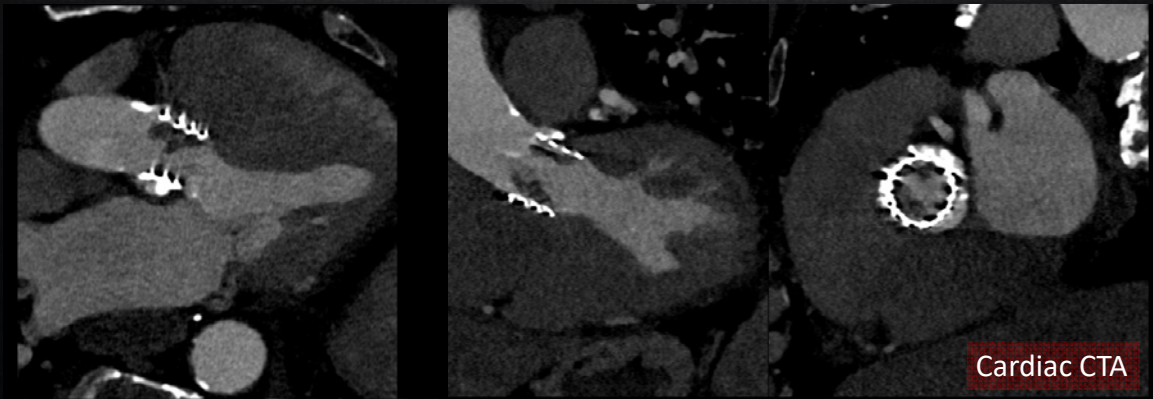
Case

74 yo Male with prior TAVR Sapien THV aortic valve presents with a cold left arm

Urgent embolectomy. + Blood cultures (Strep)



Unable to perform TEE due to **scleroderma esophagitis**.
Cardiac CT and Intracardiac echocardiogram performed
to better characterize valve.



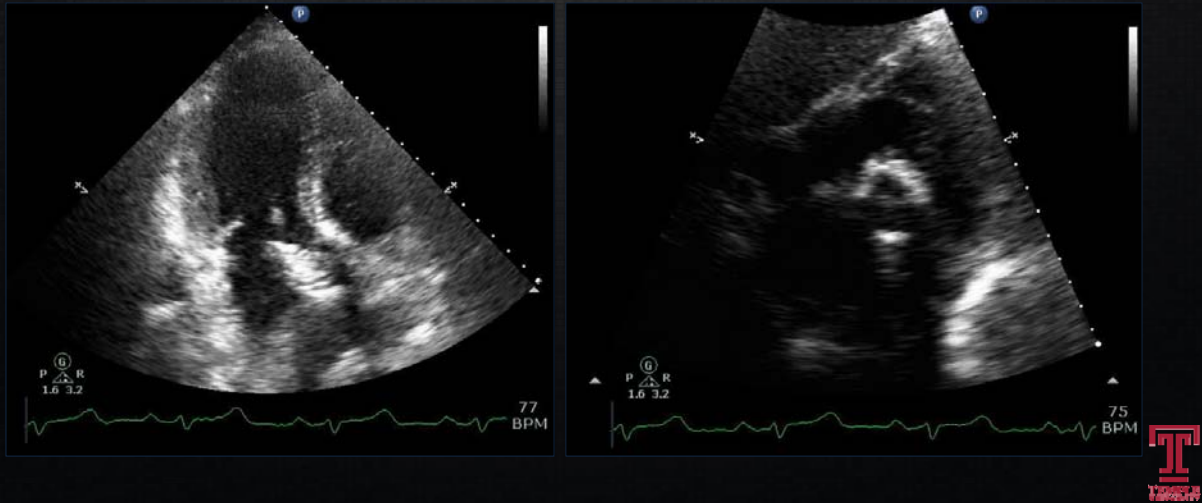
Intracardiac Echocardiography



Treated with IV antibiotics and oral anticoagulation



6 Month Follow Up



Endocarditis vs. Thrombosis

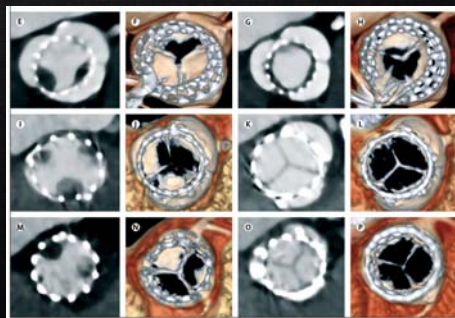
Subclinical leaflet thrombosis in surgical and transcatheter bioprosthetic aortic valves: an observational study

Tarun Chakravarty, Lars Søndergaard, John Friedman, Ole De Backer, Daniel Berman, Klaus F Kofoed, Hasan Jilaihawi, Takahiro Shiota, Yigal Abramowitz, Troels H Jørgensen, Tanya Rami, Sharjeel Israr, Gregory Fontana, Martina de Knecht, Andreas Fuchs, Patrick Lyden, Alfredo Trento, Deepak L Bhatt, Martin B Leon, Raj R Makkar, on behalf of the RESOLVE and SAVORY Investigators*

DAPT



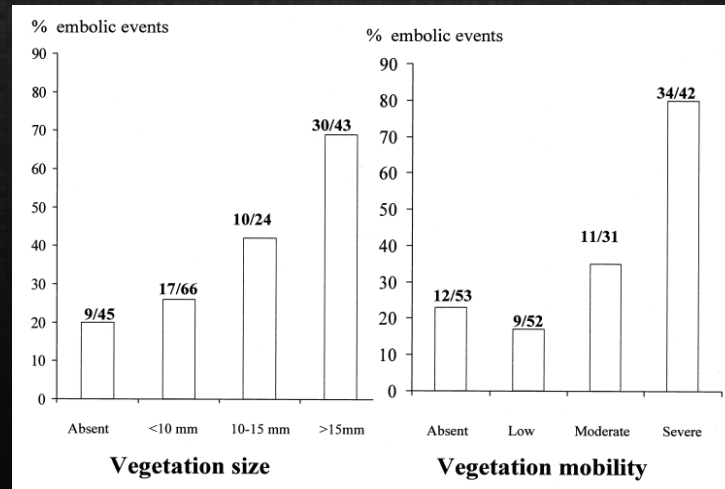
Oral Anticoagulation



Chakravarty et al. Lancet 2017



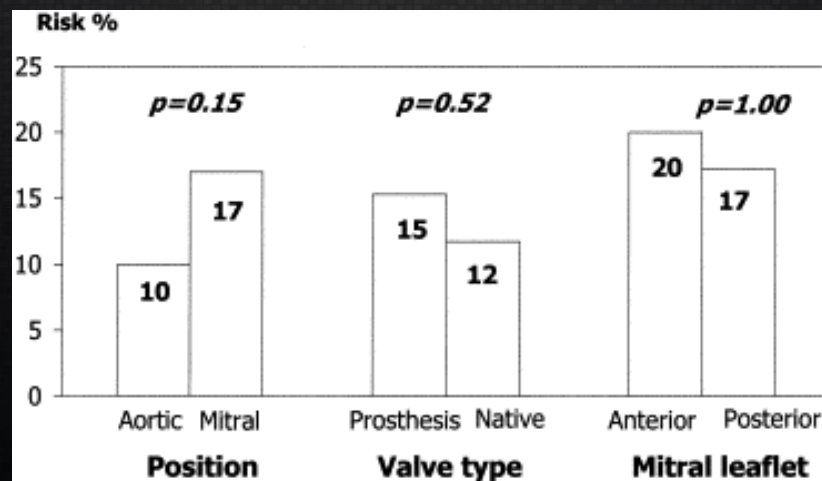
Size, Mobility and Embolic Events



DiSalvo et al. JACC 2001



Location, Location, Location

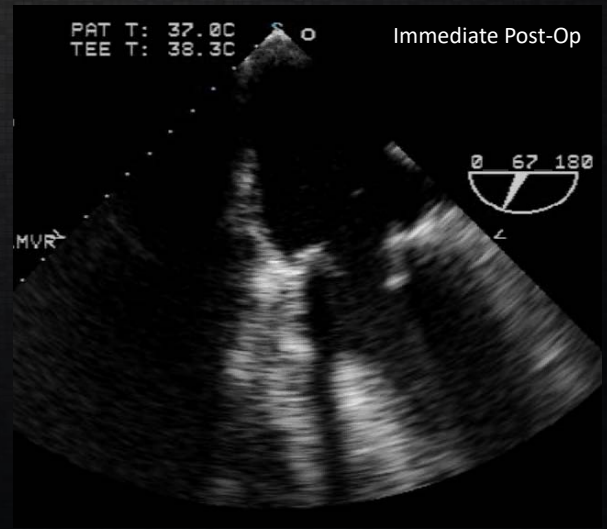


Villacosta et al. JACC 2002

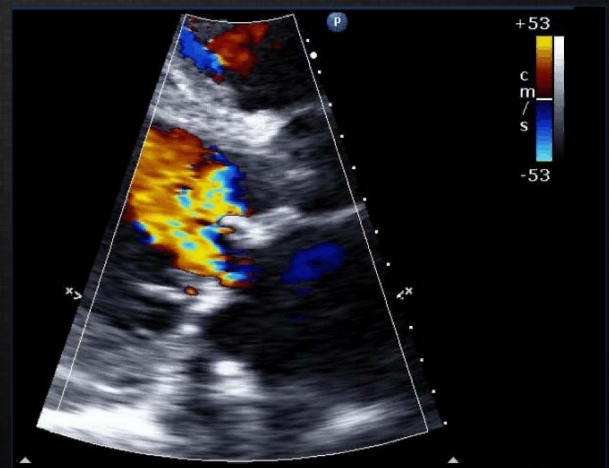
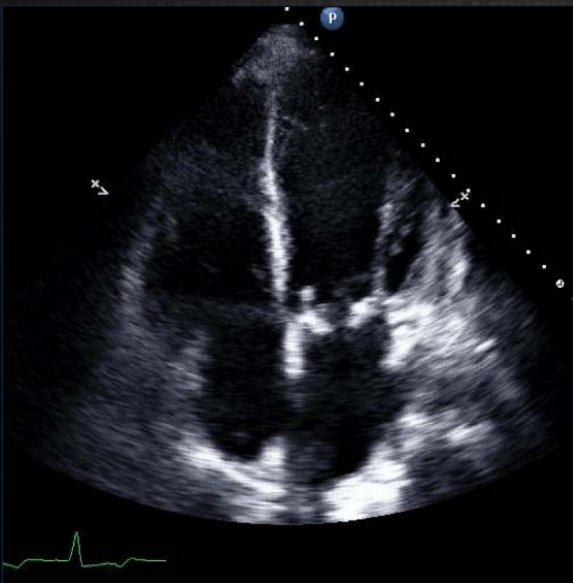


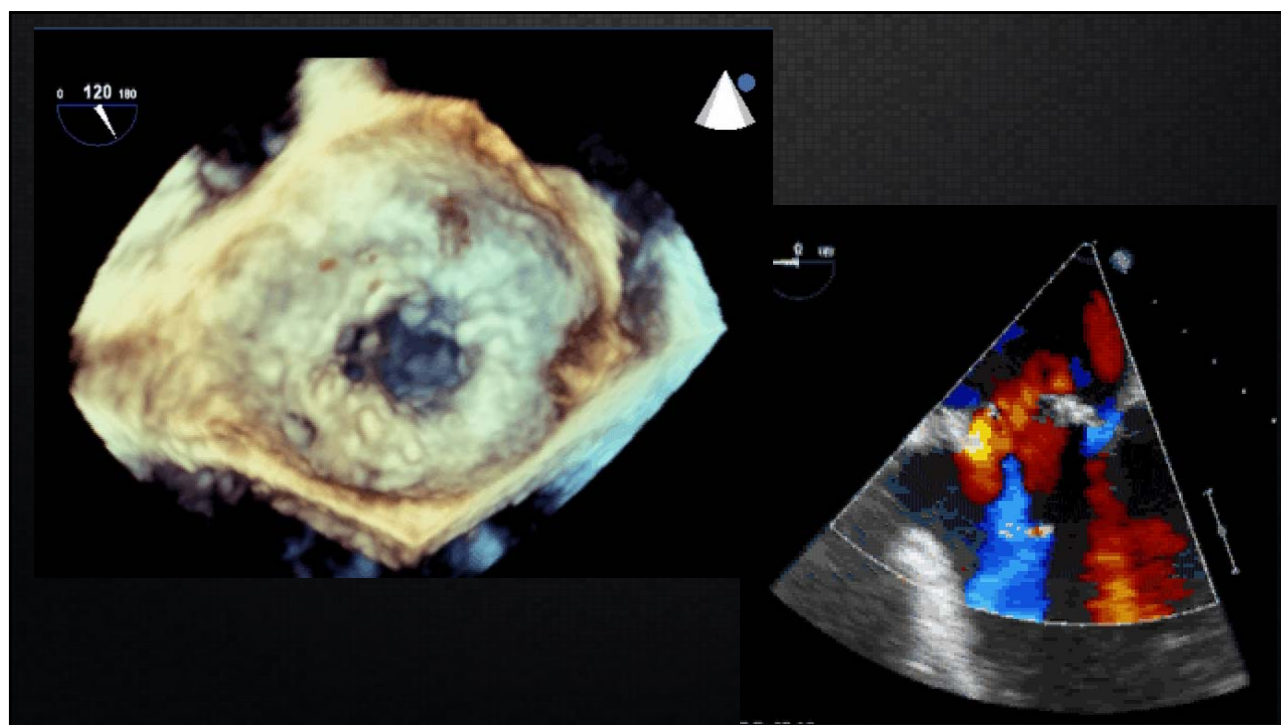
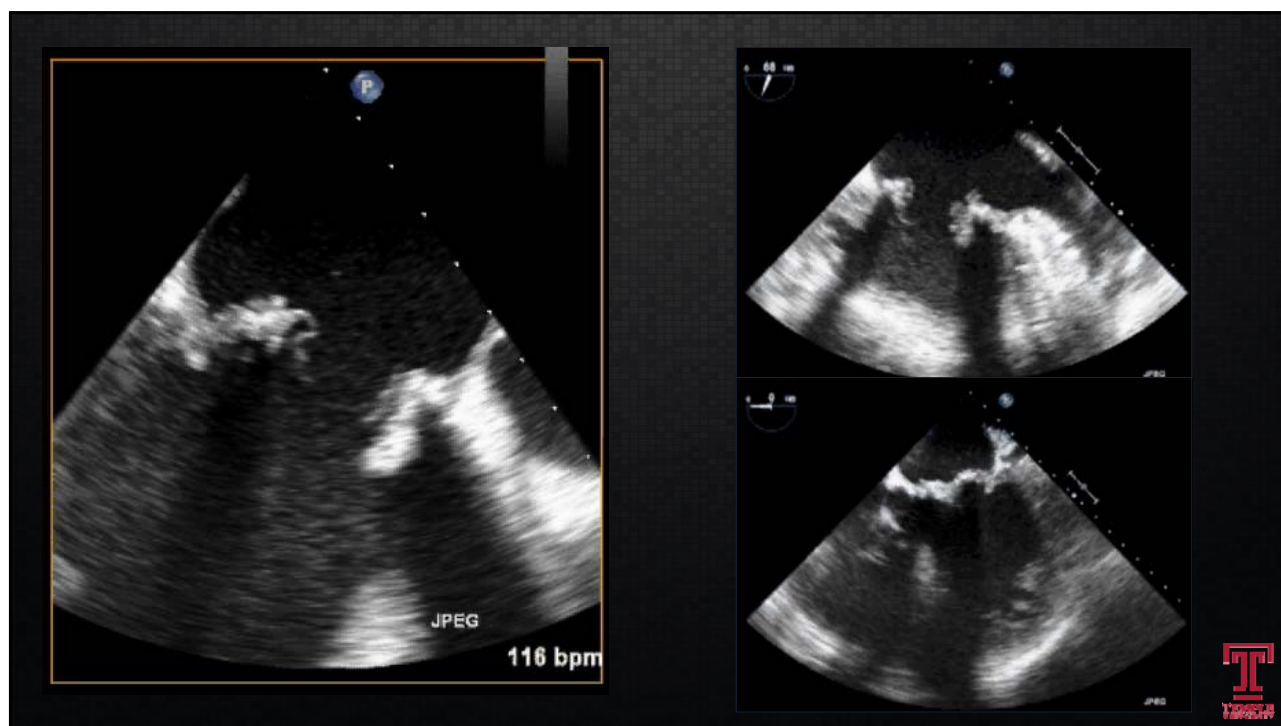
Case

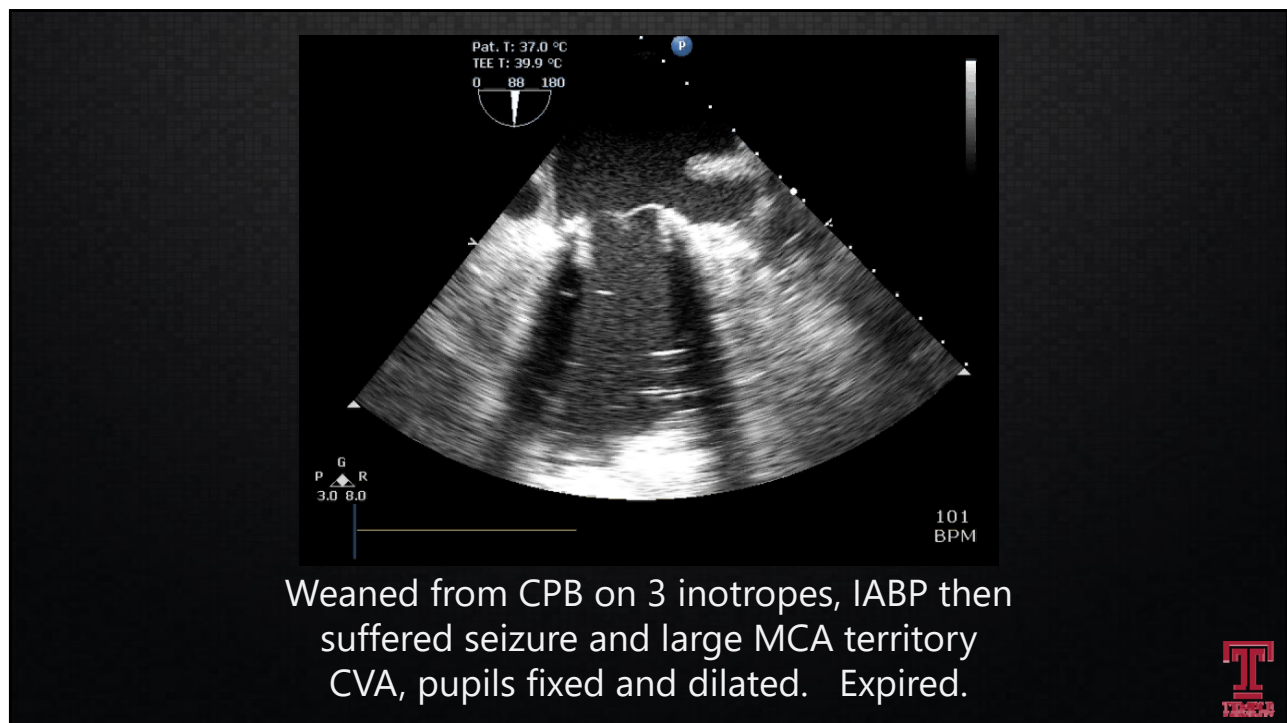
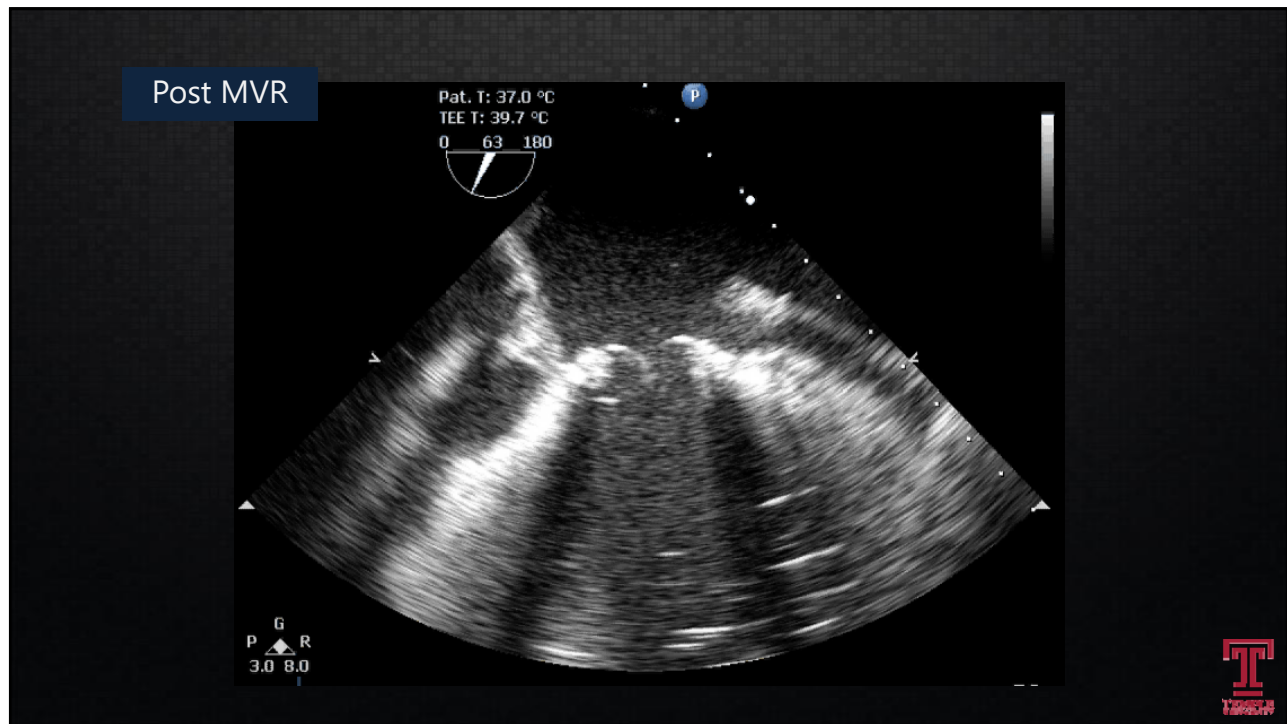
- ✓ 68 yo male
 - Bioprosthetic MVR for IE (4 months ago)
 - Severe LV dysfunction, LVEF 10-15%
 - CKD on HD, T2DM, Prior CVA



Fevers, chills, SOB, rigors; Staph epi multiple culture bottles







Prosthetic Valve Endocarditis

Piper et al. BMJ 2001

Table 1 Microbiology of early and late PVE. Authors' own findings compared to a recent European literature review³

	Early PVE (%)		Late PVE (%)	
	Own experience (n=34)	Europe (n=68)	Own experience (n=132)	Europe (n=194)
<i>Staphylococcus epidermidis</i>	29	43	21	28
<i>Staphylococcus aureus</i>	18	13	19	13
Streptococci	6	3	15*	20
Enterococci	6	2	18	7.5
HACEK	18	17	8	7
Fungi	9	6	5	4
Mixed infections	6	—	3	—
Others	6	12	7	9
Culture negative	3	4	4	12

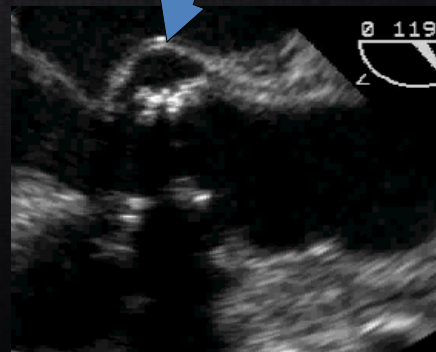
*Viridans group n=13 (10%), β haemolytic streptococci n=3 (2%), and *Streptococcus bovis* n=4 (3%).

HACEK, *Haemophilus*, *Actinobacillus*, *Cardiobacterium*, *Eikenella*, *Kingella*.



Prosthetic Valve Endocarditis

- ✓ Perivalvular regurgitation
- ✓ Dehiscence/rocking motion
- ✓ Bulging of the annulus
- ✓ Necessitates TEE



ASCeXAM Focus

- ✓ Review
 - Guidelines for prophylaxis
 - Diagnosis and indications for TEE
 - Identification of complications
 - Prognostic (echocardiographic) features
 - Indications for surgery



ASCeXAM Focus

- ✓ Appropriate indications for TEE in IE
- ✓ Echocardiographic features of vegetations as described in modified Duke criteria
- ✓ Complications of IE and terminology
- ✓ Follow-up study if high suspicion and initial study negative



